Dairy Herd Improvement

by introducing high milk production into a herd of high testing cows

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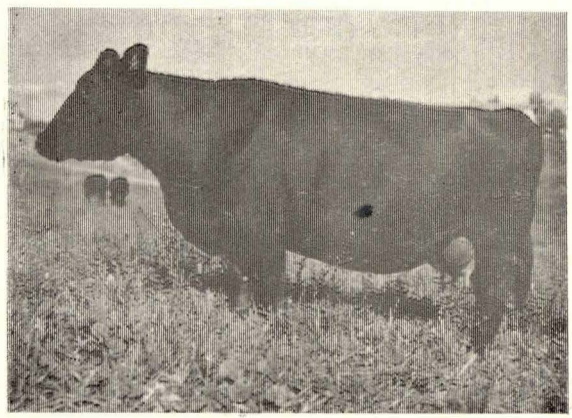
husbandman



Purebred Red Dane No. 276. Six-record average, 13,065 milk, 519 fat. Total production to date 93,672 milk, 3,731 fat, 305 days M.E.

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DAIRY HERD IMPROVEMENT

MILK and milk fat production have both been improved by crossing good Holstein or Red Dane bulls with Guernsey cows (1). The mature equivalent production (M. E.) for 365 days, 3 times milking of Holstein-Guernsey crosses is reported at 17,186 pounds of milk and 805 pounds of fat compared with their dams average of 10,897 pounds of milk and 555 pounds of fat. The Dane-Guernsey crosses averaged 18,149 pounds of milk and 803 pounds of fat as against their dams average of 11,163 pounds of milk and 546 pounds of fat.

Autry (2) reported crossbreeding experiments with Jersey cows and good Holstein bulls. The M.E. production of the crossbreds was 11,880 pounds of milk and 487 pounds of fat compared with 6,730 pounds of milk and 317 pounds of fat for the dams on twice-a-day milking for a 305 day lactation.

M.E. Fohrman's bibliography and literature review (1) of crossbreeding dairy cattle indicates that systematic crossbreeding of such animals largely is confined to the past 50 years. Several advantages seem to exist under certain conditions.

Special conditions were discovered in 1948 when an expanded farm research program was initiated in Alaska's Matanuska Valley, where a state-owned experiment station herd was then dominated by low producing, high testing Guernsey cows. The existence of this herd provided an opportunity to undertake a study to obtain some precise estimates of how rapidly and efficiently a systematic crossbreeding program might improve the production volumes of this kind of a dairy cow population. Made available at that time by the U.S. Department of Agriculture Research Center at Beltsville, Maryland, were good sires of both the Holstein and Red Dane breeds. A cooperative undertaking was then established involving an out-crossing system that had previously not been widely attempted.

The wholesale price of fluid milk in the Matanuska Valley has, since World War II, gradually declined from $11 to somewhat less than $10 per 100 pounds of 4 per cent milk, with a 10c differential for each butterfat point above or below 4 per cent. With this good farm return for fresh fluid milk and no butterfat market it is not economical to sacrifice production volumes for high butterfat. High testing lower volume cows cannot compete with high volume low testing cows. A low testing cow producing the same quantities of milk fat as a high testing cow returns a greater net income because of the greater volume she produces, even though her feed requirements are higher because of her greater size and greater volume of milk. Table 1 illustrates actual differences realized in the Matanuska Valley milkshed.

Even if a purebred Guernsey produces as much fat as a cross, the cross's greater volume has given $172 more gross income than the purebred. It costs about $90 more to feed the larger crossbred, leaving $82 more net income for the cross.

The original plan of obtaining the comparisons reported herein was limited to crossing Holstein and Red Dane sires on production-proved purebred Guernsey cows, retaining a Guernsey bull to

Table 1. — Calculated yearly gross income of crosses and their purebred sisters, at prices prevailing in the Matanuska Valley in early 1964 (M.E. 305 days 2x)

Cows	Milk	Fat	Gross income
	Lbs	Lbs	
Red Dane-Guernsey cross			
7 crosses	10,357	445	$1,067
Purebreds	6,957	339	756
Dams	6,928	370	786
Holstein-Guernsey cross			
5 crosses	10,712	476	1,118
Purebreds	8,249	395	890
Dams	6,577	342	737

Table 2. — Average annual herd production (M.E.* 305 days 2x), and average annual composition of the Matanuska experimental herd for selected calendar years.

Year	Milk	Fat	Herd composition and size				
			Guern.	Hol.	Dane Crosses		Total
	Lbs	Lbs	Number of cows				
1948	6,180	298	9.9	- -	- -	- -	9.9
1950	6,176	299	13.0	1.2	- -	- -	14.2
1952	6,913	310	8.9	5.4	2.0	3.9	20.1
1954	9,204	361	7.8	7.5	2.0	9.8	27.2
1956	11,023	436	1.0	4.5	3.8	15.9	25.2
1958	11,766	461	2.4	6.3	4.3	16.7	29.7
1960	12,313	502	0.4	6.4	2.7	20.7	30.2
1962	12,609	503	1.0	9.0	4.0	16.5	31.4

***Mature equivalent was calculated for first calf heifers on their age at date of calving and for others on their age at the first of the year.**

provide some purebred second and third generation Guernsey cows which would serve as standards of comparison. A quarter of the herd was to be bred to Holstein bulls, another quarter to Red Dane bulls, and half to Guernsey bulls. Two-breed crosses were to be bred to a bull of the third breed, while 3-breed crosses were to be bred back to the Guernsey bull.

After obtaining a number of the 3-breed animals, a change was made in the plan. The 3-breed crosses were thenceforth bred back to Red Dane or Holstein. If they were from Red Dane sires, they were bred to Holstein, while those from the Holstein bull were bred to a Red Dane. This change was made after a loss in volume of milk when Guernsey sires were used on 3-breed crosses had been demonstrated.

Another change was to initiate a minor collateral system of interbreeding Red Dane and Holstein bloodlines as opportunities arose.

Red Dane-Guernsey female crosses were the first additions to arrive under this improvement plan. During the first year and a half, matings to the Holstein sires resulted in only seven bull calves. The first 3-breed crosses were therefore all Holstein x Dane-Guernsey.

During the first five years (1948 through 1952) little progress could be reflected, primarily because all dams, regardless of condition or production capacity, were retained to bear females. Additions to the milking herd through adding new animals unrelated to the original dams was limited to five Holstein and two Red Dane cows introduced before 1953. The first two additions calved in 1950, while the last dropped its first in 1952. By 1953 some culling was initiated, not on the basis of production, but to insure retaining family lines. When a dam had borne one or two female calves she could be discarded, but all dams were kept until at least one female calf was dropped.

Until 1957 the total size of the experimental herd was limited to 25 milkers by lack of physical space. Thereafter 32 could be housed and managed in the herd.

Environmental factors impinging on herd performance have been maintained as uniform and as constant as possible from year to year. All roughage fed during this study has been grown in Alaska, most of it being harvested from the fields of the Matanuska Experiment Station Farm. Its quality has gradually improved over the years. Grain concentrates have been purchased, usually from outside of Alaska. Although some management practices necessarily change over the years these changes are not thought to have masked nor,

Table 3. — Production of Dane-Guernsey crosses compared with that of their Guernsey dams (M.E. 305 days 2x)

Herd no.	Crosses Milk	Fat	Herd no.	Dams Milk	Fat
	Lbs	Lbs		Lbs	Lbs
204 . .	9,645	420	30 . .	7,175	426
208 . .	9,241	391	943 . .	8,912	371
209 . .	8,231	379	7 . .	6,754	320
215 . .	9,557	386	58 . .	8,495	437
236 . .	12,488	535	102 . .	5,752	287
238 . .	9,799	427	104 . .	6,445	359
239 . .	11,844	470	95 . .	6,016	298
241 . .	11,925	523	26 . .	7,509	368
251 . .	10,420	439	206 . .	7,192	405
252 . .	9,977	487	100 . .	7,273	396
224 . .	8,964	398	202 . .	4,834	253
422 . .	11,127	507	265 . .	8,065	400
437 . .	10,557	438	261 . .	9,973	500
207 . .	6,510	278	25 . .	7,841	415
Mean	10,024	434	Mean	7,303	374

on the other hand, to have reinforced production improvements attributable chiefly to inherent and inherited capabilities. The improved production per milk cow realized since 1953 and reflected in Table 2 is considered to be due both to the systematic outcrossing program imposed on the original herd and to the few introduced females. As a result of this program production of the experimental herd has nearly doubled in the space of a decade.

RED DANE X GUERNSEY

During the course of this improvement study, 14 Red Dane-Guernsey crosses were obtained through the systematic breeding program and were consolidated into the herd. The best records of these crosses are compared with their dam's best records in Table 3. Mean annual production of the crosses exceeded their dam's mean by 2,721 pounds. Twelve cross records exceeded those of their dams. Four crosses produced less fat than their dams. Cross Number 207 with the lowest production record calved the first time with only three good quarters and never realized the full capability of a normal cow.

HOLSTEIN X GUERNSEY

In a similar manner 7 Holstein-Guernsey crosses were added to the herd in the course of the study. All were better milk producers than their dams and were equal or better butterfat producers. Best records of these crosses and their dams are listed in Table 4 where it is seen that the mean production of the crosses topped that of their dams by 4,515 pounds. In the entire program this group gave the largest production gains over their dams. Their dams as a group were inferior to those conceiving the first generation Red Dane-Guernsey crosses.

Table 4. — Production of Holstein-Guernsey crosses compared with that of their Guernsey dams (M.E. 305 days 2x)

Herd no.	Crosses Milk	Fat	Herd no.	Dams Milk	Fat
	Lbs	Lbs		Lbs	Lbs
216 . .	10,268	434	1437 . .	5,406	288
221 . .	12,852	518	104 . .	6,445	359
224 . .	10,697	428	35 . .	8,855	428
225 . .	10,072	447	49 . .	5,364	275
248 . .	10,178	440	102 . .	5,752	287
263 . .	10,984	527	95 . .	5,967	295
279 . .	11,537	544	206 . .	7,192	405
Mean	10,941	477	Mean	6,426	334

Table 5. — Production of Holstein-Dane-Guernsey crosses compared with that of their Dane-Guernsey dams (M.E. 305 2x)

Herd no.	Crosses Milk	Fat	Herd no.	Dams Milk	Fat
	Lbs	Lbs		Lbs	Lbs
231 . .	9,983	410	209 . .	8,231	379
244 . .	14,575	534	215 . .	9,557	386
235 . .	12,151	551	207 . .	6,510	278
246 . .	14,631	604	207 . .	6,510	278
247 . .	12,946	468	208 . .	9,241	391
269 . .	11,298	450	239 . .	11,844	470
271 . .	11,596	485	215 . .	9,557	386
223 . .	13,958	520	204 . .	9,695	420
278 . .	12,594	534	238 . .	9,799	427
287 . .	14,542	588	241 . .	11,925	523
259 . .	13,768	446	208 . .	9,241	391
260 . .	14,544	589	207 . .	6,510	278
268 . .	11,348	485	238 . .	9,799	427
275 . .	11,101	456	241 . .	11,925	523
281 . .	13,968	558	239 . .	11,844	470
293 . .	10,564	468	251 . .	10,420	439
400 . .	13,135	585	241 . .	11,925	523
406 . .	13,038	526	236 . .	12,488	535
417 . .	15,294	706	241 . .	11,925	523
Mean	12,897	524	Mean	9,950	424

HOLSTEIN X DANE X GUERNSEY

Since the first crosses obtained were from the Red Dane bulls on Guernsey cows, the first 3-way crosses to arrive were from the Holstein sire on the Dane-Guernsey combination. The poorest Dane-Guernsey dam bore three daughters that averaged 13,775 pounds of milk (M.E. 305 days2x) and 581 pounds of fat on their best records. Nineteen Holstein-Dane-Guernsey calves were eventually available to the program. Their best records are compared with their dams' best records in Table 5. Here it is seen that the 3-combination daughters' performance exceeded their dams' by 2,947 pounds

Table 6. — Production of Dane-Holstein-Guernsey crosses compared with that of their Holstein-Guernsey dams (M.E. 305 days 2x)

Herd no.	Crosses Milk	Fat	Herd no.	Dams Milk	Fat
	Lbs	Lbs		Lbs	Lbs
264 . .	12,337	560	225 . .	10,072	447
284 . .	10,809	468	224 . .	10,697	428
280 . .	11,754	535	225 . .	10,072	447
291 . .	11,045	460	263 . .	10,984	527
413 . .	14,688	490	221 . .	12,852	518
425 . .	13,439	610	279 . .	11,537	544
429 . .	10,244	433	263 . .	10,984	527
Mean	12,045	508	Mean	11,028	491

This is somewhat more gain than realized from the first cross of the Dane and Guernsey bloodlines. Of the 19 daughters, 17 produced more milk than their dams, only two proving inferior. More fat was produced by 16 of the 19 daughters.

Since only 10 of the Dane-Guernsey cows dropped daughters, the average production for this group of dams differs from the mean for best record production of all the Dane-Guernsey crosses listed in Table 3.

DANE X HOLSTEIN X GUERNSEY

Five of the seven 2-breed Holstein-Guernsey cows dropped seven 3-breed daughters sired by Red Dane bulls during the course of this study. These daughters' best records exceed their dams' by 1,027 pounds of milk (Table 6). As with the other crosses based on the Guernsey line, this improved milk production volume was accompanied by a slight drop in its butterfat content as expressed in per cent.

3-BREED CROSSES COMPARED

No significant production differences developed between the two combinations of the 3-breed crosses. Mean production of the Holstein-Dane-Guernsey daughters (Table 5) exceeded that of the Dane-Holstein-Guernsey cross (Table 6) by only 852 pounds. Holstein-Dane-Guernsey milk contained 4.1 per cent butterfat, while that of the Dane-Holstein-Guernsey progeny contained 4.2 per cent, based on comparisons of their best production records.

CROSSES & BREEDS COMPARED

Twelve crossbred daughters and 12 purebred sisters were obtained from ten of the Guernsey dams. Crosses were sired by three Dane and three Holstein bulls while the purebred sisters were sired by three Guerney bulls. Most of the crosses were in the herd at the same time as the purebreds, 18 records of each line being available for the same years. For this reason, it is thought that environmental differences exerted little influence on the production differences that developed and that are summarized in Table 7.

This summary shows that the crossbred progeny exceeded by some 40 per cent the average production volume of their purebred sisters. Total average fat of the crosses exceeded that of their sisters by 27 per cent, although butterfat content for the respective groups was 4.4 per cent compared to 4.8 per cent. All crossbreds were better than their purebred sisters in producing both milk and fat.

In volume of production, the crossbred progeny as a group excelled their dams by 55 per cent while the purebred progeny exceeded their dams by only some 10 per cent.

Table 7. — Summary of comparative performance of 12 crosses and their purebred sisters, and improvement over their Guernsey dams, mean of 18 records for the same years (M.E. 305 days 2x)

Group	Milk	Fat	Gain
	Lbs	Lbs	*
Dams	6,782	358	- -
Crossbred daughters	10,505	458	55
Purebred daughters	7,496	362	10

*Percent improvement of progeny's milk production over their dams.

Table 8. — Production of Guernsey 335 sire's progeny and their dams.

Herd no.	Crosses Milk	Crosses Fat	Dams Milk	Dams Fat	Breed of dam
	Lbs	Lbs	Lbs	Lbs	
274	10,962	457	10,697	428	H-G
285	12,257	587	13,842	459	D-H
288	11,630	530	14,481	514	H
289	10,624	475	9,983	410	H-DG
294	9,359	428	14,631	604	H-DG
295	11,606	510	12,946	468	H-DG
296	8,406	411	14,575	534	H-DG
415	9,540	412	12,125	475	D-H
Mean	10,548	476	12,910	487	

SIRES' ROLE

The Holstein and Red Dane bulls involved in this study were, compared to the Guernsey sires, genetically superior for production. While the Guernsey bulls had some very good daughters out of 3-breed crosses and Holstein dams, their progeny generally was inferior in production volume to those of the other breed sires.

In Table 8 are listed the best records of eight daughters out of Guernsey Sire 335, seven having crossbred dams. Only two of these daughters gave more milk than their dams although five produced more butterfat. Most of the daughters can be called good cows, except this breeding line held no promise of general improvement in volume. For this reason, the overall experimental system was modified to eliminate further backcrossing to the Guernsey sires. Henceforth 3-breed crosses were all bred back to either the Dane or Holstein bulls.

It is, of course, impractical to compare production potentials of either breeds or sires unless proof is obtained from a number of daughters of the same dams in the same herd. The herd improvement program discussed here fortunately yielded a number of sisters by the Red Dane and Holstein sires on the same dams. The best records of these 16 sister-pairs, together with those of their dams, are listed in Table 9.

In comparing these records, it must be realized that groups rather than individuals are discussed. There were seven Holstein sires and six Red Dane sires involved, together with 16 dams and 32 daughters (16 sister-pairs). The sister pairs were all in the herd at the same time. A number of their records were made at the same time. Environmental differences were thus held to a minimum. The greatest uncontrolled source of variation is the age of the cows at which their

Table 9. — Comparison of sister's production from 7 Holstein and 6 Dane sires (M.E. 305 days 2x)

Herd no.	Dane sire	Milk	Fat	Herd no.	Holstein sire	Milk	Fat	Dam Milk	Dam Fat
		Lbs	Lbs			Lbs	Lbs	Lbs	Lbs
236	597	12,486	535	248	2912	10,178	440	5,893	295
242	597	12,670	508	P231	2912	9,983	410	8,231	379
239	597	11,844	470	263	2595	10,984	527	5,976	295
238	597	9,799	427	221	2595	12,852	518	6,445	359
251	17	10,420	439	279	368	11,537	544	7,192	405
418	235	12,485	458	401	7969	13,948	512	12,768	446
422	235	11,223	511	443	368	11,372	409	8,549	424
411	145	11,546	428	430	107	13,721	469	11,298	450
207	597	16,955	587	231	368	15,769	588	12,079	415
277	707	12,125	475	P258	368	15,802	554	14,481	514
240	163	17,456	688	225	368	18,347	702	14,756	566
250	163	15,828	608	F258	133	18,461	623	13,273	517
234	597	13,842	459	218	2595	8,806	359	9,350	326
268	163	17,111	621	262	133	12,062	493	18,233	709
435	707	13,228	489	409	107	17,040	596	15,802	554
436	707	14,539	543	405	107	15,399	522	19,327	740
Mean		13,347	515	Mean		13,516	510	11,541	462

records were made. Most confounding from this source is thought to be eliminated by conversion of actual records to mature equivalents (M.E.).

Production of the daughters of the Holstein sires essentially equals the production of daughters sired by the Red Danes, the difference being only a little more than 1 per cent. As in the foregoing tables, the records in Table 9 show both sires possess about the same capability for transmitting production inheritance. When 19 records of the 16 sister-pairs for the same years are compared, production for the Dane sires is revealed to average 12,958 pounds of milk (500 pounds of fat) and for the Holstein sires 13,421 pounds (502 pounds of fat).

ENVIRONMENT

This herd improvement program is evaluated chiefly by comparing daughters' records with their dams'. There always persists some questions about how much of the difference in records should be attributed to year-to-year management changes. This is particularly true for those dam-daughter pairs whose best records were made in different years because they were not in the herd at the same time. Table 10, listing lactation averages by year-of-calving for all components of the herd from 1951 through 1961, assists in dispelling some questions about the importance of environment. In discussing this table, it is emphasized

Table 10. — Mean production of the Guernsey and Guernsey cross herd (M.E. 305 days 2x), by various crosses for the years indicated.

Year	Total			Guernsey			D-G			H-G		
	Cows	Milk	Fat	Cows	Milk	Fat	Cows	Milk	Fat	Cows	Milk	Fat
	No.	Lbs	Lbs	No.	Lbs	Lbs	No.	Lbs	Lbs	No.	Lbs	Lbs
1951	12	5,541	255	10	5,274	244	2	6,879	313	-	- -	-
1952	15	6,245	296	9	5,291	266	5	7,157	322	1	10,268	434
1953	16	6,862	294	9	5,552	249	5	7,813	321	2	10,378	429
1954	19	8,246	355	7	7,081	324	6	8,091	339	4	10,103	423
1955	21	10,412	441	4	7,787	351	6	10,574	463	6	10,432	443
1956	13	10,654	434	1	10,072	395	4	10,001	443	3	10,525	427
1957	18	10,453	422	2	9,405	418	4	9,271	411	2	9,188	402
1958	20	11,430	486	2	9,044	445	2	10,936	496	2	11,260	535
1959	18	10,873	467	1	9,973	500	-	- -	-	1	10,078	492
1960	17	11,527	479	1	8,927	446	-	- -	-	-	- -	-
1961	14	11,837	486	1	9,056	441	2	10,388	470	-	- -	-
Total	183	. . . . .		47	. . . . .		36	. . . . .		21	. . . . .	
Mean		9,464	402		7,951	371		9,012	398		10,279	448

Year	H-D-G			D-H-G			Others			G-H-D-G		
	Cows	Milk	Fat	Cows	Milk	Fat	Cows	Milk	Fat	Cows	Milk	Fat
	No.	Lbs	Lbs	No.	Lbs	Lbs	No.	Lbs	Lbs	No.	Lbs	Lbs
1954	2	9,079	375	-	- -	-	-	-	-	-	- -	-
1955	5	12,293	483	-	- -	-	-	-	-	-	- -	-
1956	5	11,370	438	-	- -	-	-	-	-	-	- -	-
1957	8	11,685	437	1	9,363	394	1	11,037	419	-	- -	-
1958	10	12,027	475	3	11,634	521	1	10,962	457	-	- -	-
1959	9	11,201	475	2	9,846	420	2	12,832	489	3	9,833	439
1960	6	12,303	517	2	12,866	475	5	11,513	452	3	9,974	462
1961	2	14,162	616	3	11,885	502	6	11,983	446	-	- -	-
Total	47	. . . . .		11	. . . . .		15	. . . . .		6	. . . . .	
Mean		11,765	477		11,119	462		11,665	453		9,904	450

Table 11. — Comparative mean production of crosses and Guernseys for the years they were in the herd together (M.E. 305 days 2x) and improved gross income of crosses over Guernseys in terms of milk prices then existing in the Matanuska Valley milkshed.

Comparison	Records	Years	Milk	Fat	Gain
	Number		Lbs	Lbs	%
Guernsey	45	9	7,618	348	100
D-G	36	9	9,012	398	117
Guernsey	35	8	8,026	369	100
H-G	21	8	10,279	448	125
Guernsey	19	8	8,918	415	100
H-DG	47	8	11,765	477	125
Guernsey	7	5	9,281	450	100
D-HG	11	5	11,118	462	112
Guernsey	2	2	9,450	473	100
G-HDG	6	2	9,902	450	101

that none of these cows calved in March, April, May and June; nearly all calved between late July through December of each year.

Comparing Guernseys (47 records) with the Dane-Guernsey crosses (36 records) shows, for example, that members of the two groups were together in the herd for nine years. Yearly production means for the Dane-Guernsey crosses exceeded the Guernsey's average records in seven of these nine years. Dane-Guernsey fat records excelled in eight of the nine years.

In a similar manner Guernsey and Holstein-Guernsey crosses (21 records) were included in the herd for a total of eight years. The crosses' yearly average production was ahead of the Guernseys' in seven of these years (six years for average total butterfat).

Table 11a. — Comparative mean production of all combinations of crosses of the Guernseys and of the total herd (M.E. 305 days 2x) and gain in milk production over Guernsey for the period 1955 through 1961.

Comparison	Milk	Fat	Gain
	Lbs	Lbs	%
Herd total	11,027	459	121
Guernsey	9,101	428	100
D-G	10,234	457	112
H-G	10,297	460	113
H-D-G	12,149	492	133
D-H-G	11,119	462	122
G-H-D-G	9,904	450	109
Other	11,665	453	128

Although overall differences in averages were slight, the Holstein-Guernsey crosses produced greater average records than the Dane-Guernsey crosses during five of the seven years they were in the herd together.

Considering the 3-breed crosses, the Holstein-Dane-Guernseys excelled the Dane-Guernseys in all six years they were in the herd together. The Dane-Holstein-Guernsey crosses excelled the Holstein-Guernsey crosses during two of the three years they were together.

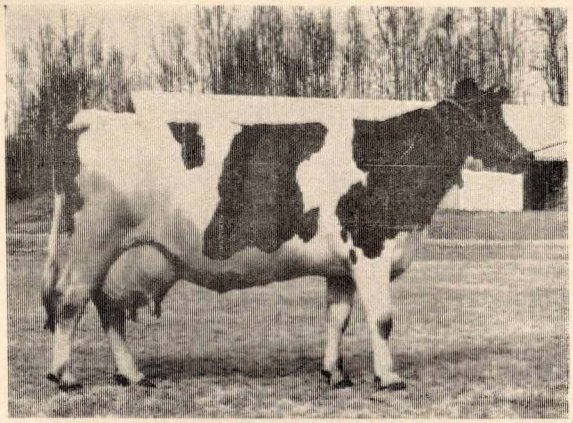
Comparisons of all crossbred generations with the purebred Guernsey line records for those years the two groups were in the herd together are shown in Table 11. Largest gains attributable to cross breeding were obtained in the first generation by the Holstein sires on Guernsey, and in the second generation by the Holstein sires on Dane-Guernsey crosses. Gains of intermediate magnitude resulted from breeding Guernseys and Holstein-Guernseys with the Red Dane sires.

Confining comparisons to the years 1955 through 1961 and, moreover, to only those years the various groups were in the herd together gives the gains listed in Table 11a. In this tabulation the relative gains remain in the same order for the various groups compared with the Guernsey parent line. Magnitude of the gains is somewhat different than in the foregoing tables, because poor records of the original inferior Guernsey dams, made before 1955, are eliminated.

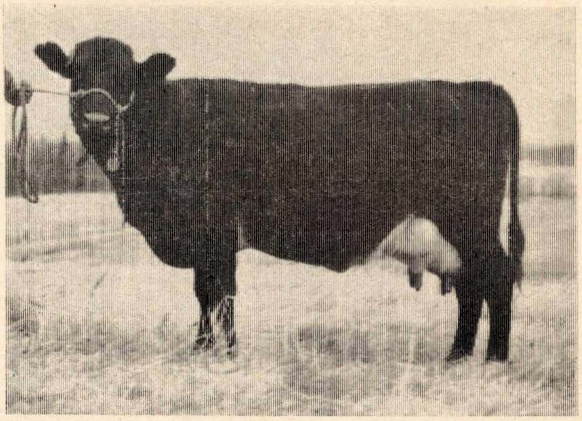
DANES & HOLSTEINS

Five Holstein and two Red Dane cows were introduced into the Matanuska experimental herd before 1953. Two of the Holsteins were excellent producers, the rest were poor. The Red Dane dams were imported from the Dairy Research Center at Beltsville, and have over 13 years of lactations nearly equalling the best Holstein production records, there being only 222 pounds of fat corrected milk difference. By 1951, 10 out of the herd total of 22 animals were these cows together with their daughters.

Production of the Holstein-Dane complement is compared with the Guernsey complement and records of the total herd by lactations in Table 12. Of



Purebred Holstein No. 273. Six-record average, 15,840 milk, 600 fat. Total production, 104,323 milk, 4,001 fat, 305 days M.E.



Holstein-DG No. 247 (3-way cross). 12,946 milk, 468 fat, 305 days M.E.

major interest is that period after 1954 when the crossbred progeny began to dominate the Guernsey complement, and the Holstein line began to dominate the remainder of the herd. Influences of the same Holstein and Dane sires are reflected in both segments of the herd.

Table 12 includes all of the lactation records of every cow in the experimental herd during the 13-year period. There were 183 lactations for 79 Guernsey and Guernsey cross cows, 117 records for Red Dane and Holstein cows and their crosses.

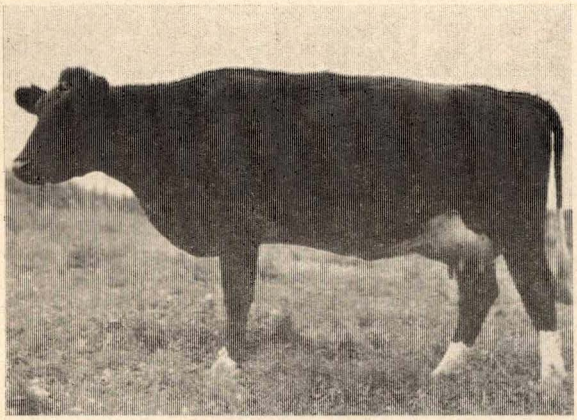
The Red Danes and Holstein started with better production than the Guernsey segment of the herd, and made nearly as rapid improvement progress, but by the second generation the Guernsey crosses were not much inferior to the Holstein-Dane members of the herd.

As with the Guernseys, breeding the poorer Holsteins with the Red Dane sires gave more rapid production increases than were obtained from the purebred line. After the 15,000 pound production level (500 pounds of fat) was attained,

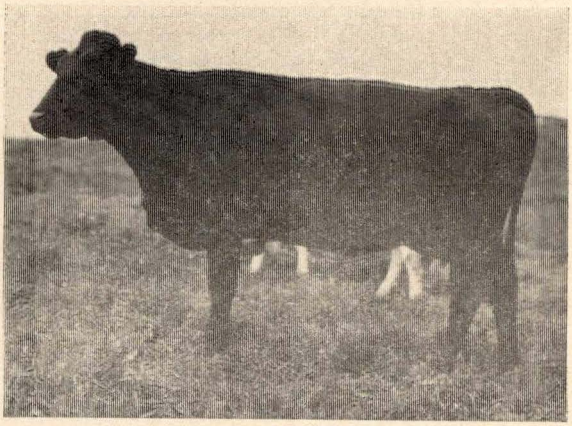
Table 12. — Comparative mean production of Guernsey and Guernsey crosses, and of purebred Holstein and Red Dane and some of their crosses in the Matanuska experimental herd, together with totals for the entire herd, by lactation (M.E. 305 days 2x)

Year	Guernsey*			Holstein and Danes**			Total herd		
	Cows	Milk	Fat	Cows	Milk	Fat	Cows	Milk	Fat
	No.	Lbs	Lbs	No.	Lbs	Lbs	No.	Lbs	Lbs
1949	9	6,092	299	1	9,645	379	10	6,447	307
1950	10	6,648	329	2	9,240	338	12	7,080	331
1951	12	5,541	255	10	8,659	324	22	6,958	286
1952	15	6,245	296	7	9,352	338	22	7,234	309
1953	16	6,862	294	10	8,722	300	26	7,577	296
1954	19	8,246	355	8	11,250	394	27	9,136	367
1955	21	10,412	441	8	11,738	436	29	10,778	440
1956	13	10,654	434	11	12,163	435	24	11,346	434
1957	18	10,453	422	13	12,304	428	31	11,229	425
1958	20	11,430	486	10	11,927	452	30	11,596	475
1959	18	10,873	467	10	11,755	468	28	11,188	467
1960	17	11,527	479	13	12,855	499	30	12,102	488
1961	14	11,837	486	17	12,216	469	31	12,045	476
Mean†		11,027	459		12,137	455		11,469	458

*And Guernsey crosses, 79 records altogether
**Holstein, Red Danes and some of their crosses, 39 records
†Mean is for the 1955 through 1961 lactations

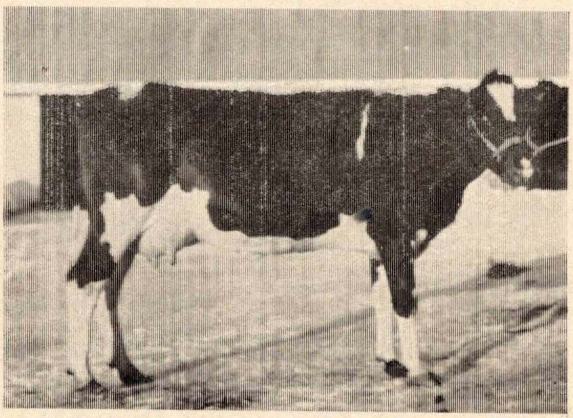


Guernsey-HDG No. 289 (Guernsey on 3-way cross). Record 10,624 milk, 475 fat, 305 days M.E.

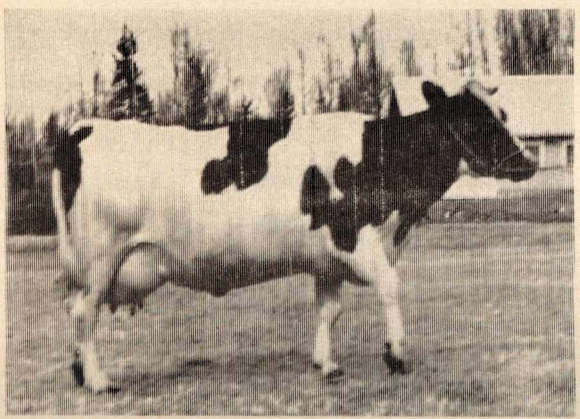


Holstein-HDG No. 401 (Holstein on 3-way cross). 13,948 milk, 512 fat, 305 days M.E.

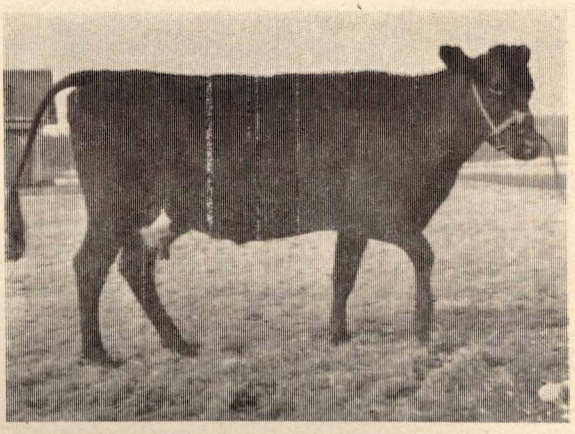
Dane-Guernsey No. 241 (1st cross). Four-record average, 11,102 milk, 489 fat, 305 days M.E.



Holstein-Guernsey No. 221 (1st cross). Five-record average, 11,553 milk, 464 fat, 305 days M.E.



Holstein-DG No. 417 (3-way cross). Two-record average, 15,020 milk, 678 fat, 305 days M.E. Daughter of No. 241, above.



Holstein-DG No. 244 (3-way cross). Three-record average, 13,415 milk, 501 fat, 305 days M.E.

Table 13. — Production by generation of Guernsey line and Guernsey crosses (M.E. 305 days 2x)

Generation	Line Cows	Line Milk	Line Fat	Crosses Cows	Crosses Milk	Crosses Fat
	No.	Lbs	Lbs	No.	Lbs	Lbs
Foundation	16	6,954	353	16	6,954	353
1st generation	9	7,809	368	19	10,282	445
2nd generation	2	8,455	398	30	12,371	508
3rd generation	1	8,927	446			
H-HDG & D-DG				4	14,773	526
G-HDG				4	9,999	456

there seemed to be no further advantage in further crossing Holstein and Red Danes. Records of two groups (purebred Holsteins and their sister crosses) of comparable high volume crosses from advanced generations of the herd are shown at the right. Further production improvement likely could be obtained only by improving the environment. While there is probably no statistically significant difference between the Dane crosses and the Holstein crosses, the slightly higher milk yield of the Holsteins would bring a $5 larger gross annual return to a farmer.

SUMMARY

Breeding a high testing herd of Guernsey cows to Holstein and Red Dane sires capable of transmitting high milk volume characteristics gave rapid gains in milk production. Figure 1 graphically illustrates the improved production attained by the first, second and some third generation crossbred cows obtained from this system, and compares these relatively large gains with the modest improvement reflected by similar generations from pure bred line breeding.

Group	Milk	Fat
	Lbs	Lbs
Dane side, 5 cows, 10 records	15,278	575
Dams, 10 records	14,808	559
Holstein side, 5 cows, 10 records	15,639	557

The four herd components represented by the four groups of bars in Figure 1 were intermingled and managed as a single unit. For this reason, differences are attributed chiefly to breeding. Environmental changes and changes in management played extremely minor roles in developing the illustrated differences.

The purebred Guernsey line, represented by the left hand group of bars, served as a standard of comparison for the Guernsey crosses (second from

Table 14. — Production by generation of Holstein and Dane lines and Holstein-Dane crosses (M.E. 305 days 2x)

Generation	Line Cows	Line Milk	Line Fat	Crosses Cows	Crosses Milk	Crosses Fat
	No.	Lbs	Lbs	No.	Lbs	Lbs
Foundation	9	11,223	409	1*	9,351	326
1st generation	10	13,946	530	1	13,842	459
2nd generation	8	13,576	499	3	13,332	509
3rd generation	2	15,605	548	2	15,439	572

*Only one cow from the left column representing the purebred line is carried over as the originating dam of the crosses listed below in the right column.

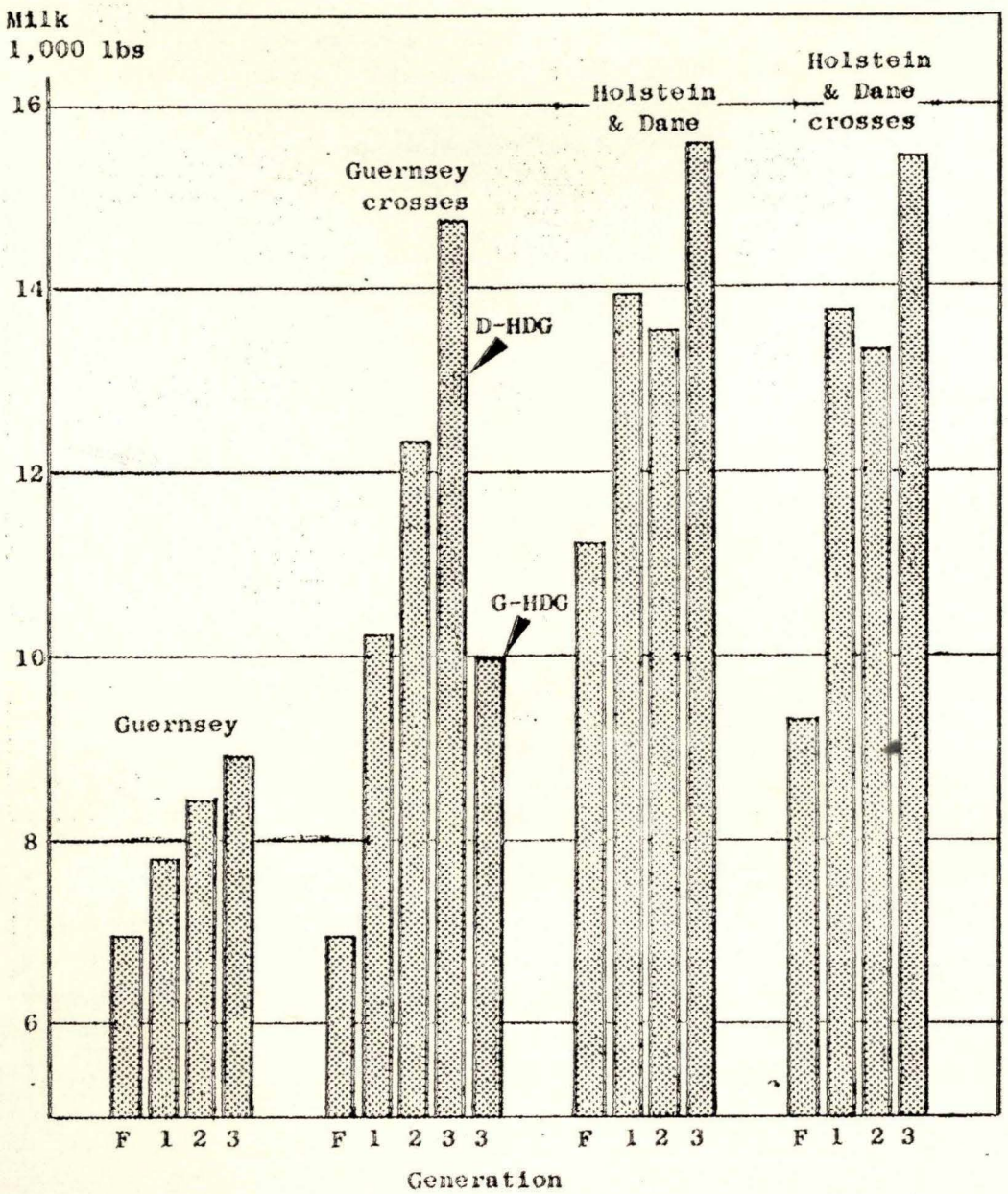


Figure 1.- Comparison of milk production by generations for the Guernsey line and for the Holstein and Red Dane line, together with production for crosses on both lines

the left). The first generation of crosses exceeded the foundation group (F) by somewhat over 3,300 pounds of milk. The second generation of crosses topped the first by another 2,000 pounds, and exceeded the foundation animals by over 5,000. Good high milking bulls gave further improvement in the crossbred animals (D-HDG), while breeding back to low volume but high testing Guernsey resulted in a regression of production (G-HDG).

Although butterfat content was raised by the high testing sire line, this factor has no eocnomic meaning in a milkshed where butterfat in excess of fresh milk retail standards has no intrinsic value. Where farm returns are calculated chiefly on milk volume, there is no point in sacrificing volume for excessive fat content.

The two groups of bars on the right in Figure 1 show that an inferior group of dams of the high producing Holstein and Red Dane breeds can give rise to a relatively high producing first generation of crosses. An implied corollary is that given a high producing foundation herd there seems to be no advantage in crossbreeding for better pro-

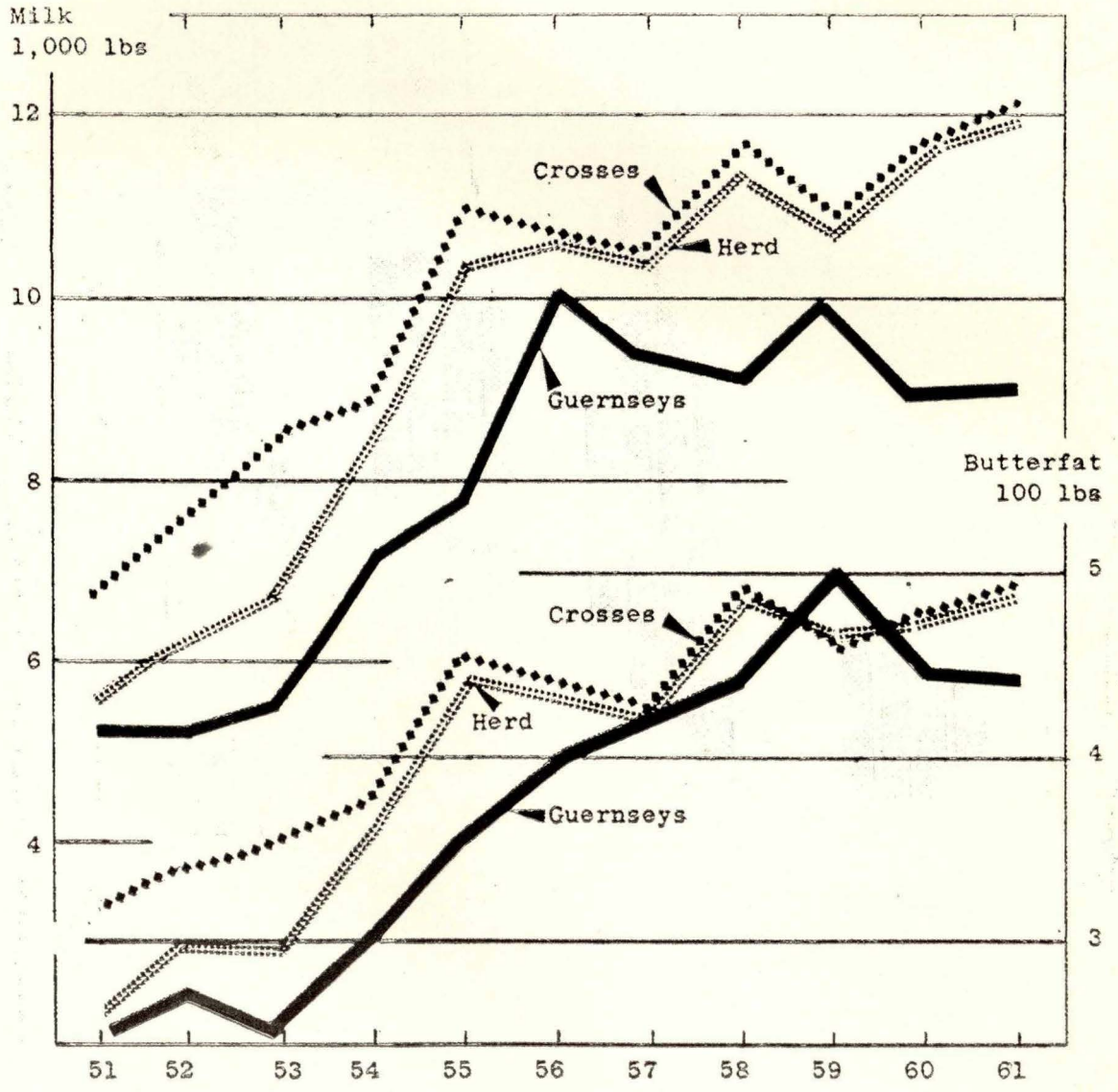


Figure 2.- Milk and fat production of the Guernseys and the Guernsey crosses, by years

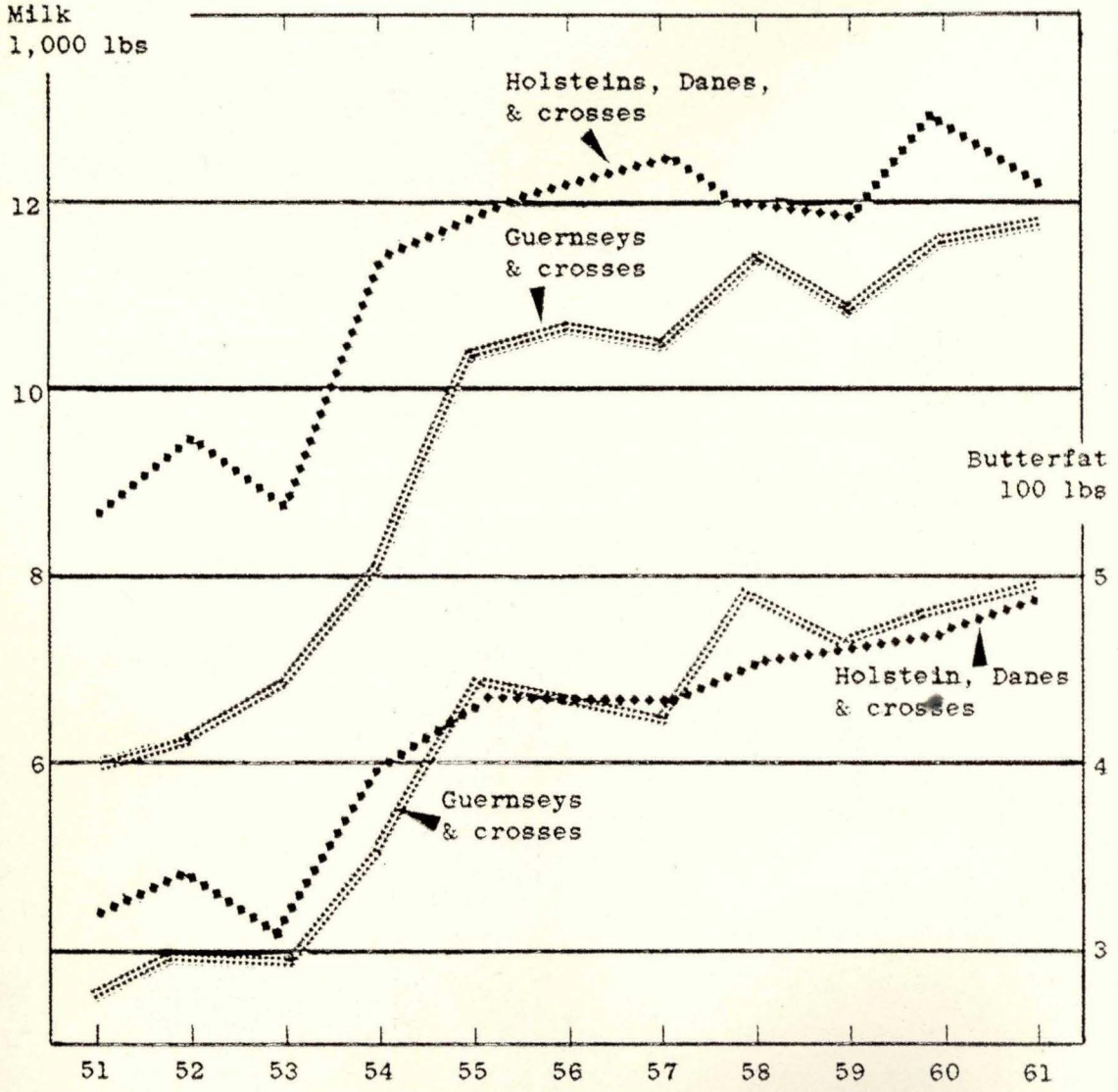


Figure 3.- Milk and fat production of the Holsteins, Danes and crosses compared with that of the Guernseys and their crosses

duction. A purebred system is equally good in holding or improving the production of an already high producing dairy herd.

Time trend milk production and butterfat curves for the Guernsey purebred line are compared with that of the Guernsey crosses in Figure 2. In these charts, which extend over an 11-year period, the effect of generations is somewhat confounded within each group, since some members of each were in the herd together. In all years the crossbred group out-produced the purebred line with respect to milk volume. Butterfat volume of the crosses initially exceeded that of the purebreds although eventually significant differences ceased to exist.

Time trend curves comparing annual production per cow of the Guernsey line and Guernsey crosses with that of the Holstein, Danes and their crossess are shown in Figure 3. While the Guernsey line shows rapid improvement, attributed chiefly to the crossbred individuals in this portion of the herd, they never attained the production volume of the Holstein-Dane segment. Butterfat production was about equal for the two lines.

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